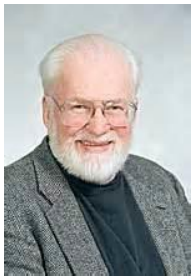
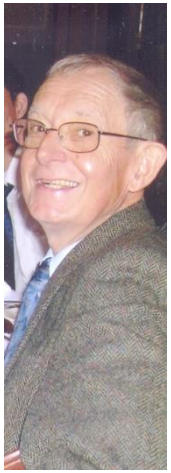
Structure and Dynamics of Interfaces: Drops and Films



J. Adin Mann, Jr., Department of Chemical and Biomolecular Engineering, Case Western Reserve University, Cleveland, OH, j.mann@case.edu;

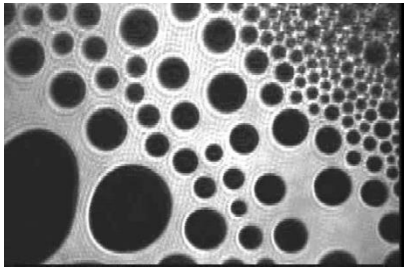
Elizabeth K. Mann, Department of Physics, Kent State University, Kent, Ohio, emann@kent.edu;



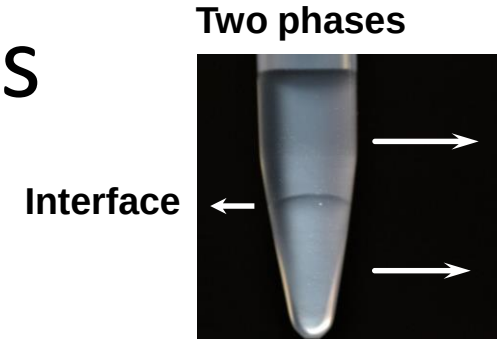
William V. Meyer, USRA at NASA Glenn Research Center, Cleveland, Ohio, william.v.meyer@nasa.gov;

A. Wilhelm Neumann, Department of Mechanical & Industrial Engineering, University of Toronto, Toronto, CA, neumann@mie.utoronto.ca>;

Hossein Tavana, Department of Biomedical Engineering, University of Akron, Akron, Ohio, tavana@uakron.edu.



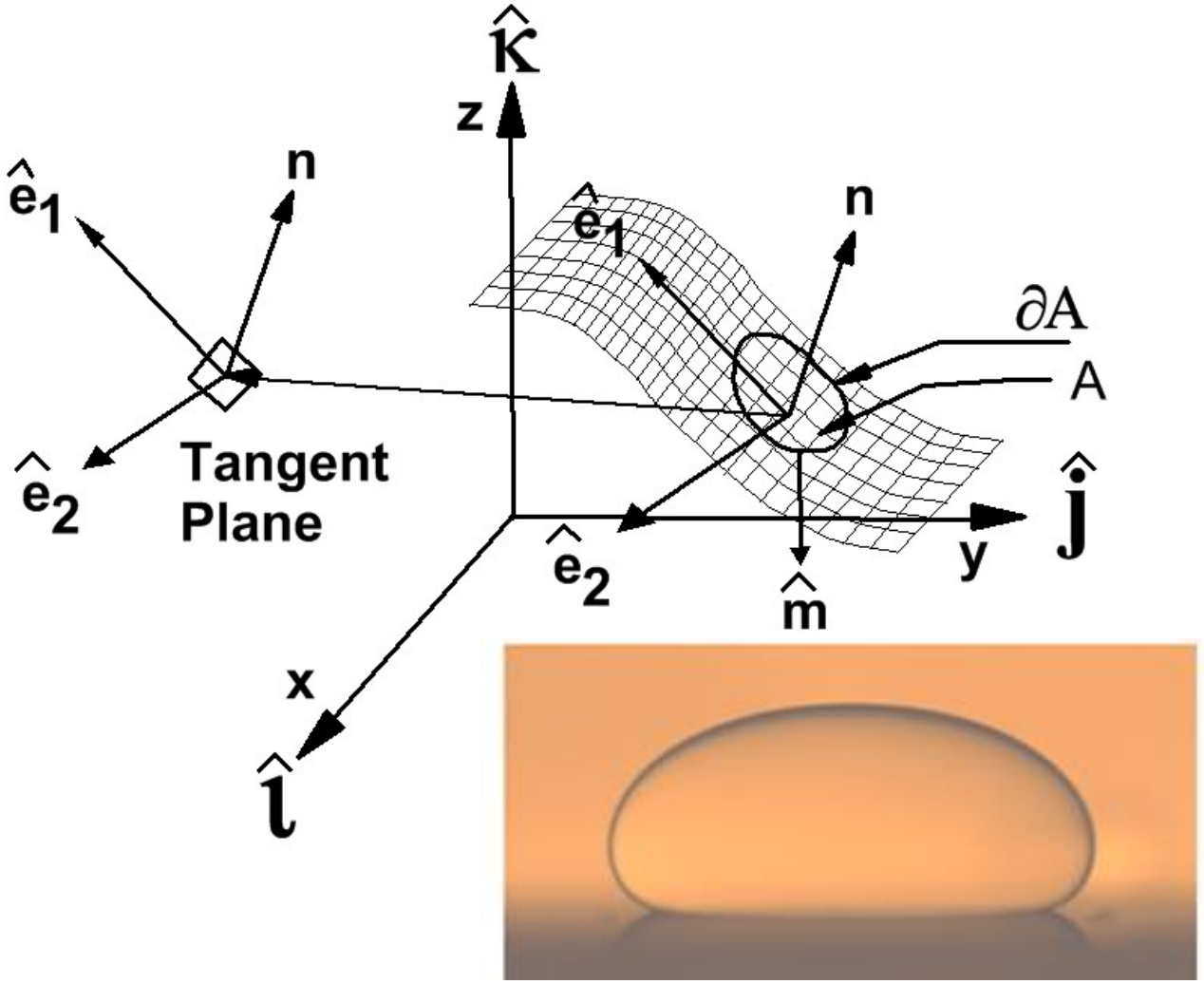
Interfacial Dynamics



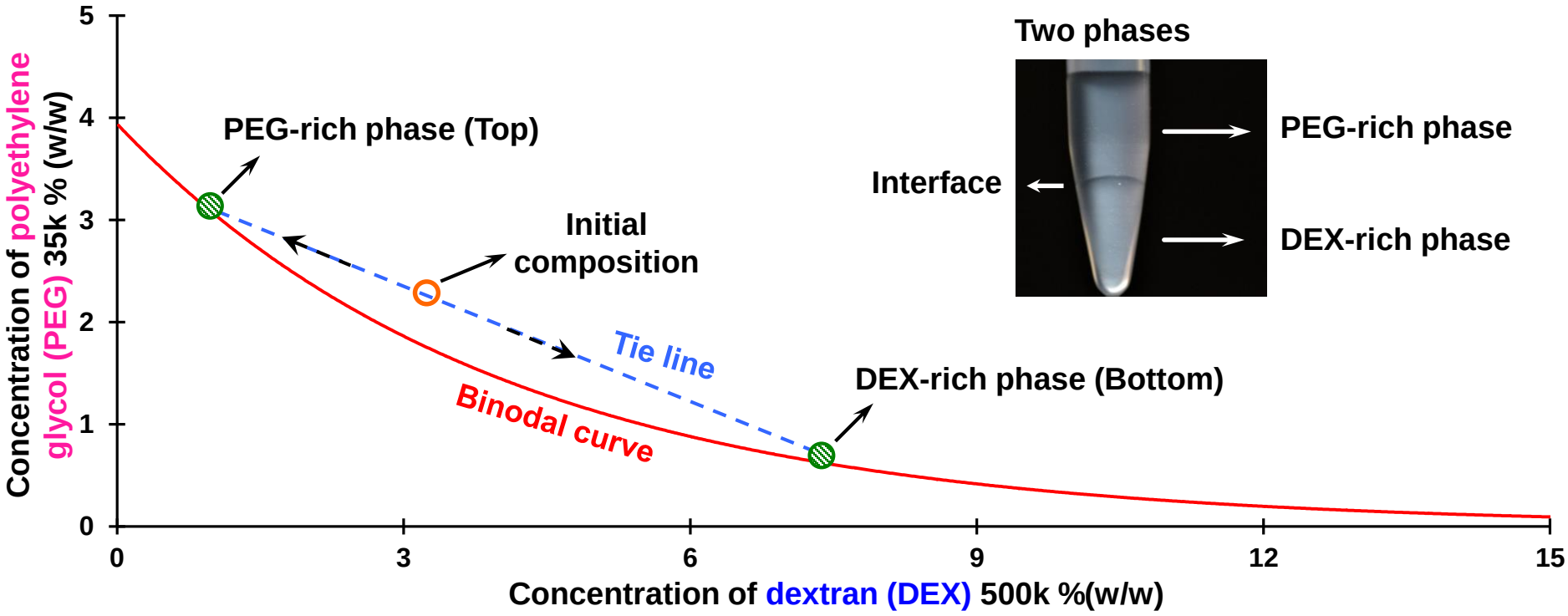
Aim: the measurements of the *structure* and *dynamics* of certain liquid – fluid interfaces using an ensemble of techniques in *collaboration*:

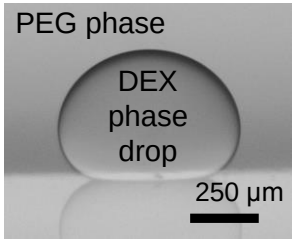
1. Surface light scattering spectroscopy (SLSS)
2. Brewster angle microscopy (BAM)
3. Drop-shape analysis
4. SLSS and BAM done on an Interfacial Footprint

Geometry of Fluctuating Interfaces



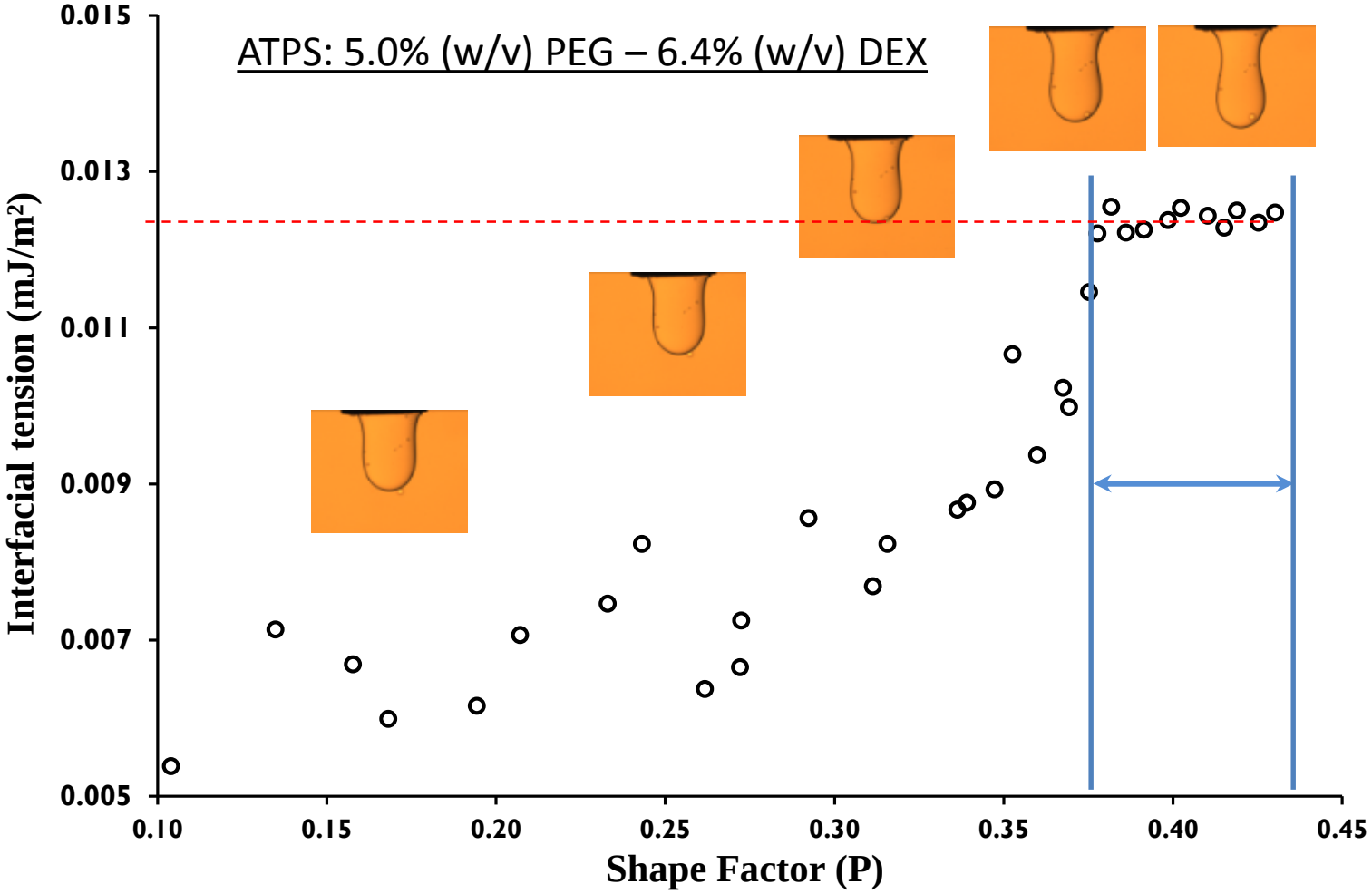
Polymeric Aqueous Two-Phase Systems (ATPS)





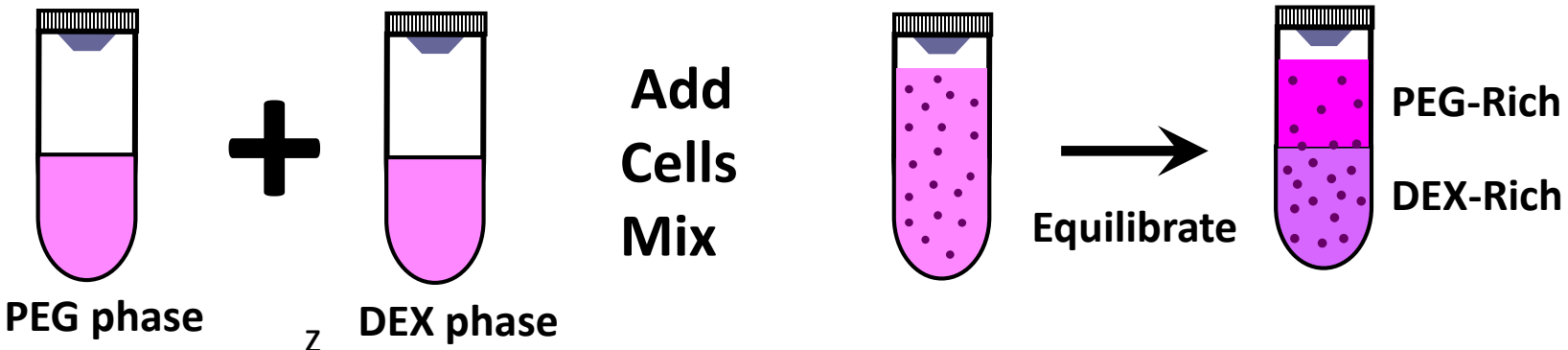
E. Atefi , J. Mann, H. Tavana, *Adv. Func. Mater.* 24 (2014) 6509-6515

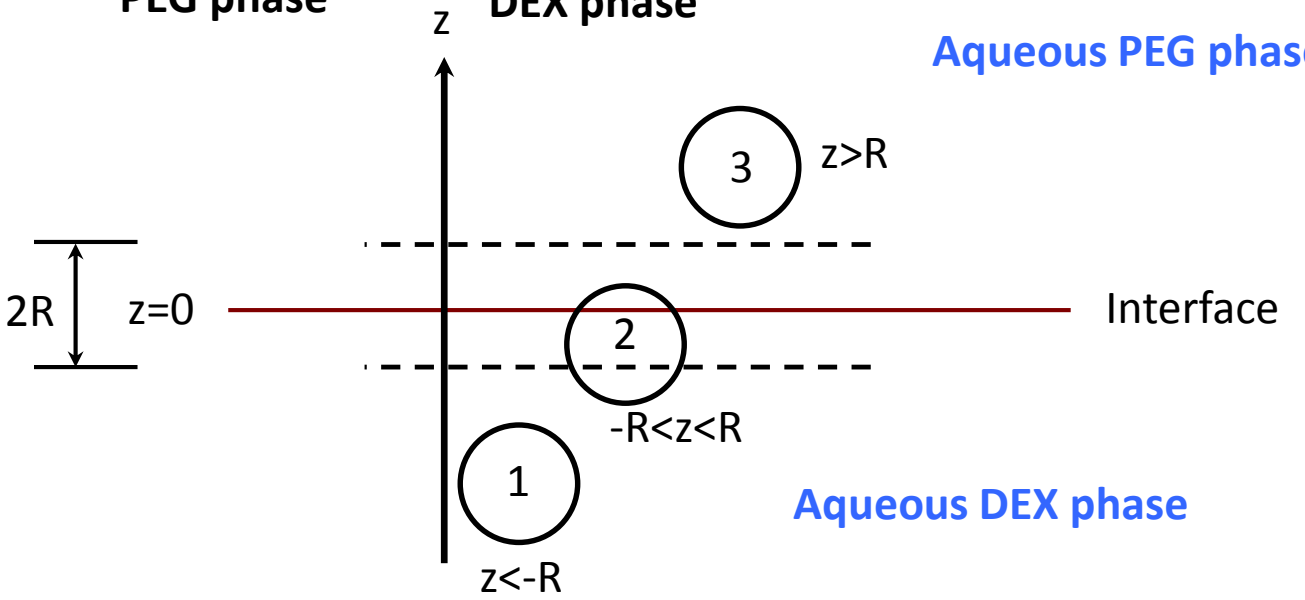
Interfacial Tension Measurements with Aqueous Two-Phase Systems (ATPS)



E. Atefi , J. Mann, H. Tavana , Langmuir, 2014, 30, 9691-9699

Modeling Cell Partition

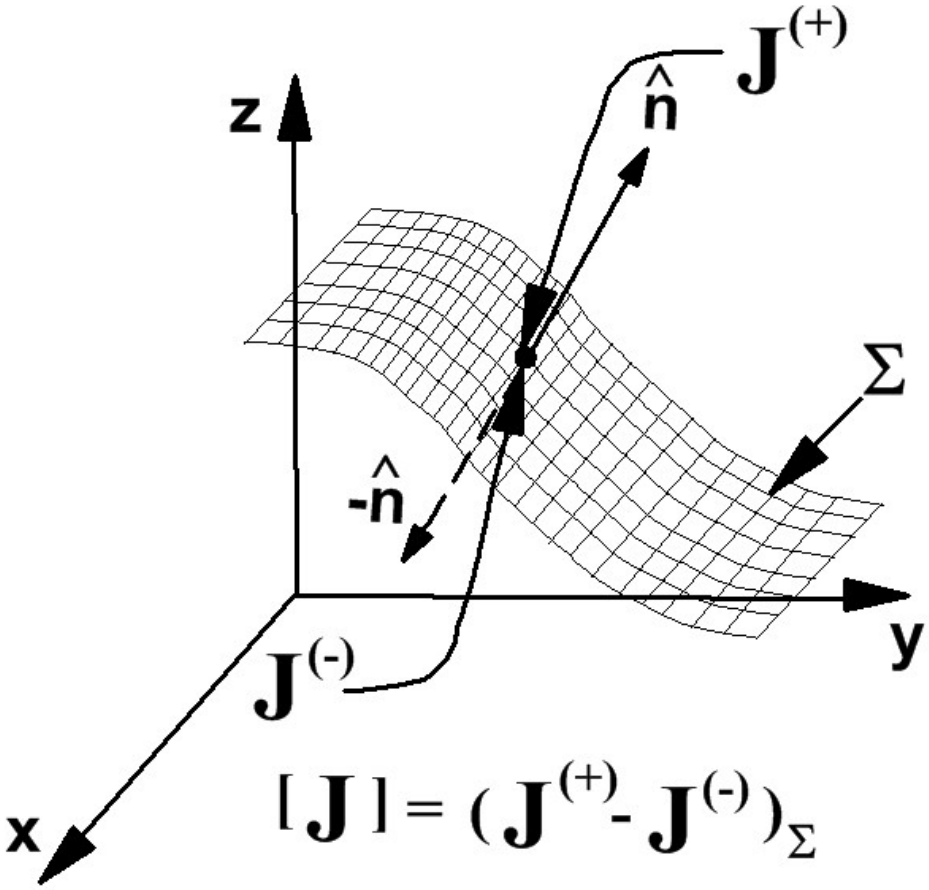




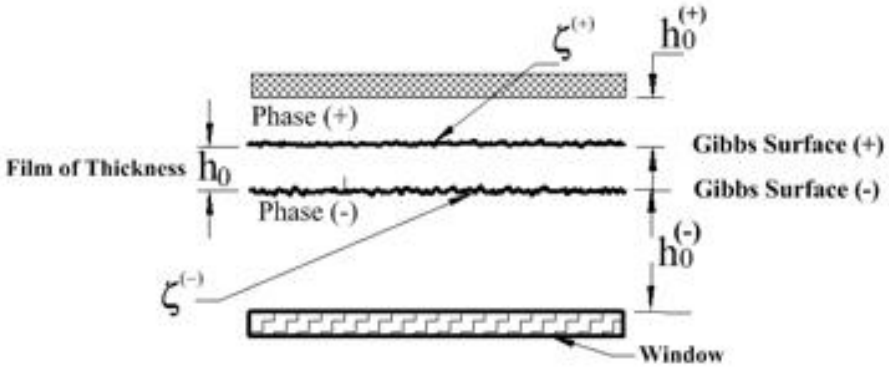
Ehsan Atefi

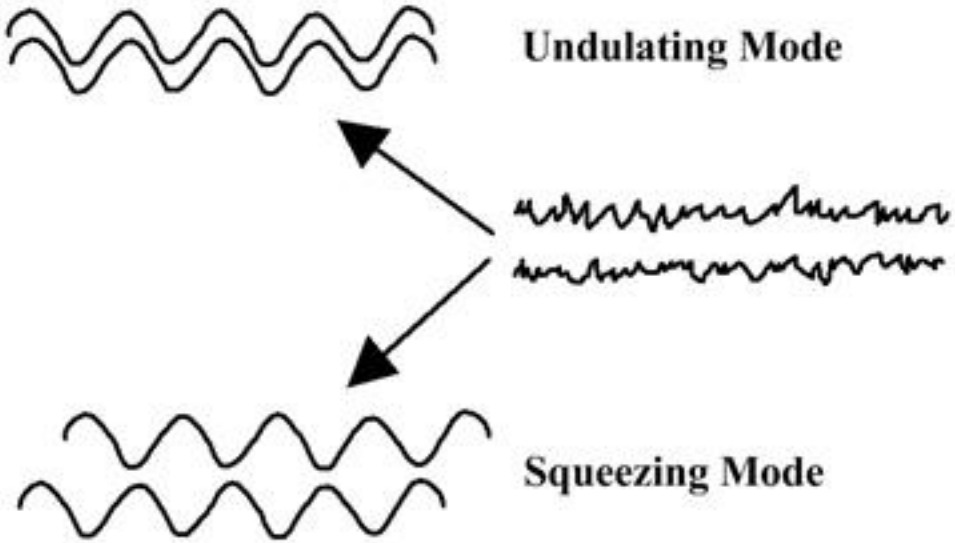
Based on Theory of “Flotation” Beyond Gravity Effects

Fluctuations in [P] generates Ripplons

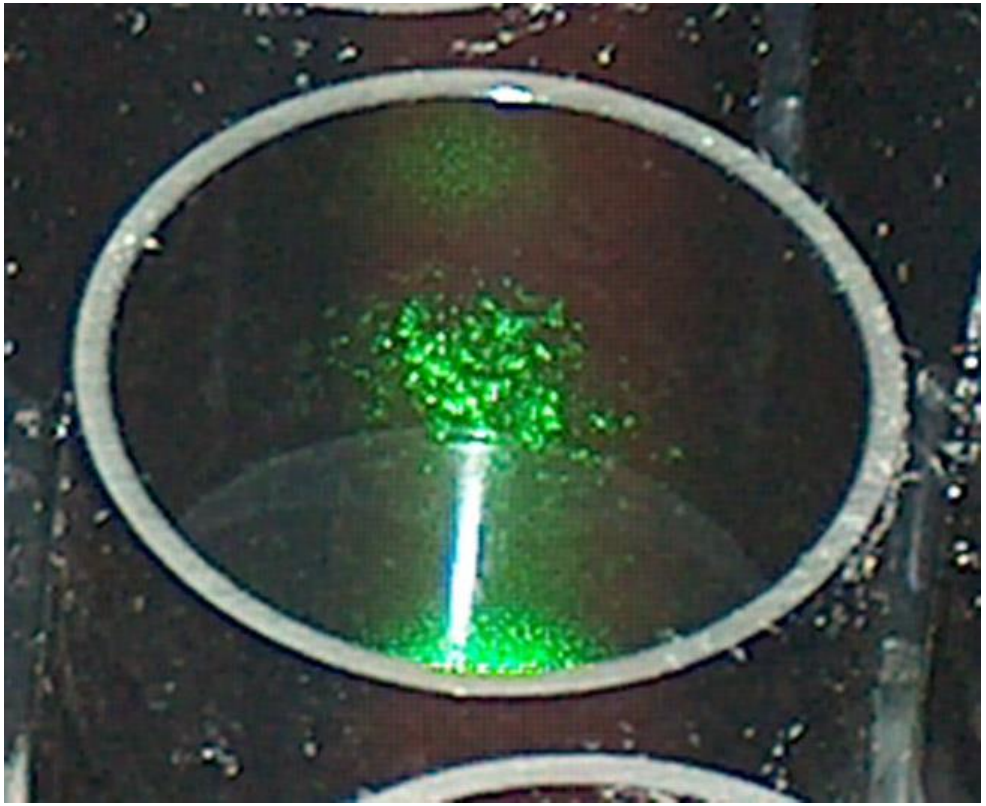


The Very Low Interfacial Tension Suggests A Complex Interface For Example:





Footprint of the incident beam



Capillary waves for measuring mechanical properties of Monolayers

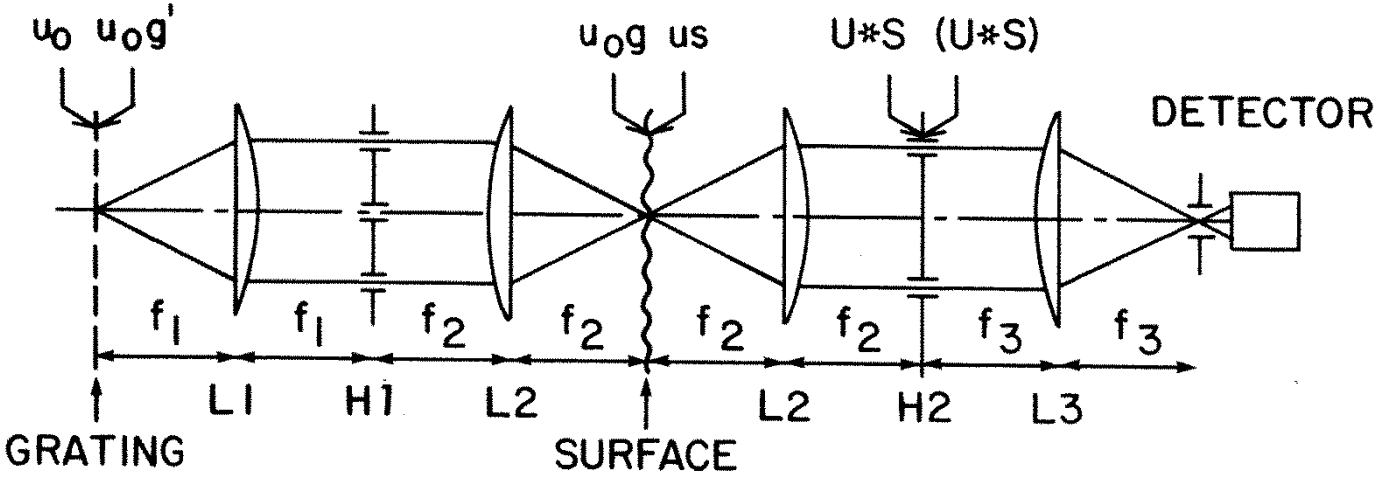
- Mann, J. A., Crouser, P. D., Meyer, W. V.,
  Surface Fluctuation Spectroscopy
  By Surface-Light-Scattering Spectroscopy.
  Applied Optics (24) 4092-4112 (2001)

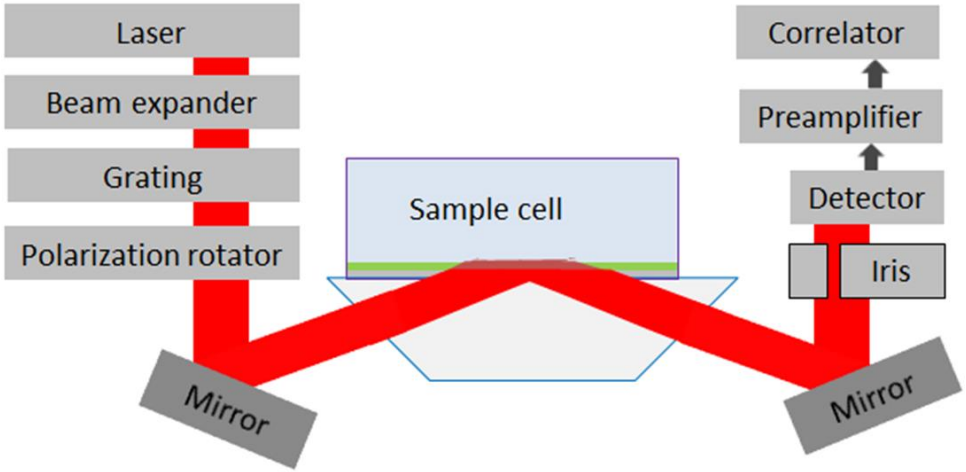
- $$<|\zeta_q|^2>=\frac{K_B T}{(\gamma+\frac{g\Delta\rho}{q^2}+B_e q^2)q^2 A_0}$$

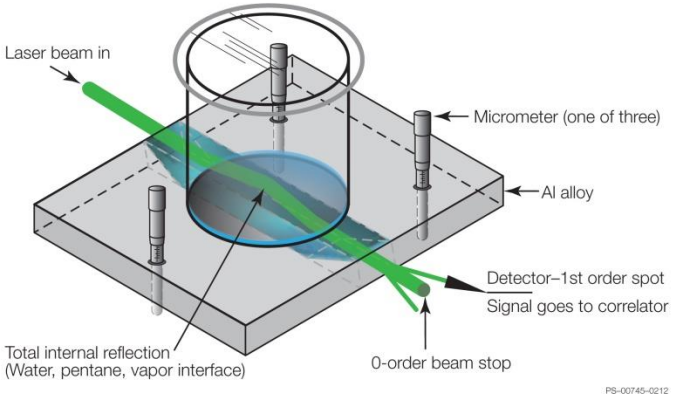
- $$\frac{\rho\omega_0^{\ 2}}{\gamma^* q^2|q|}=Y_1(visco-elastic\ \ parameters)\approx 1$$

- The spectrum function G(Parm,q; freq) is derived using **ζq<<1**
- But including all known surface and volume effects.

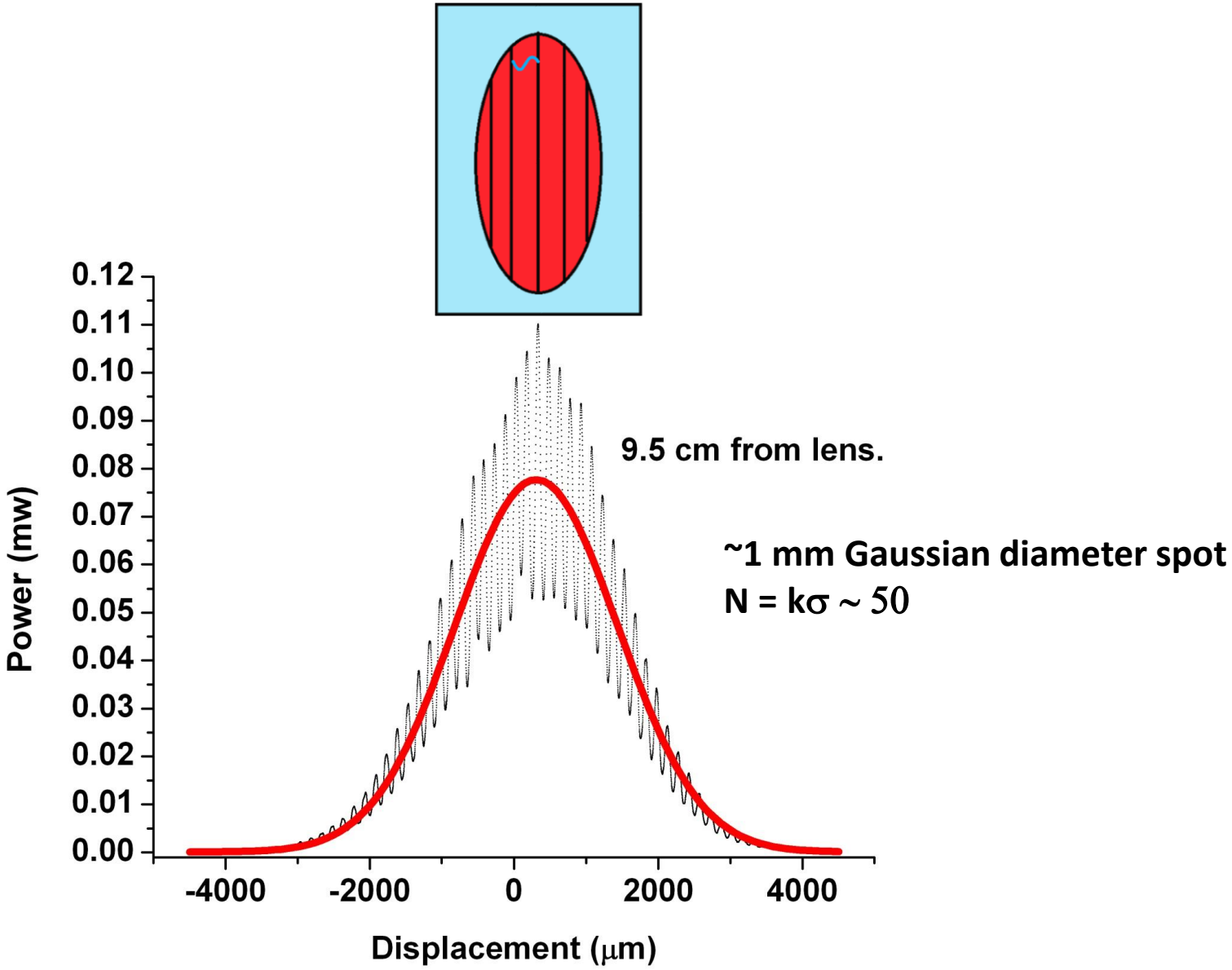
Optics For Surface Light Scattering Spectroscopy



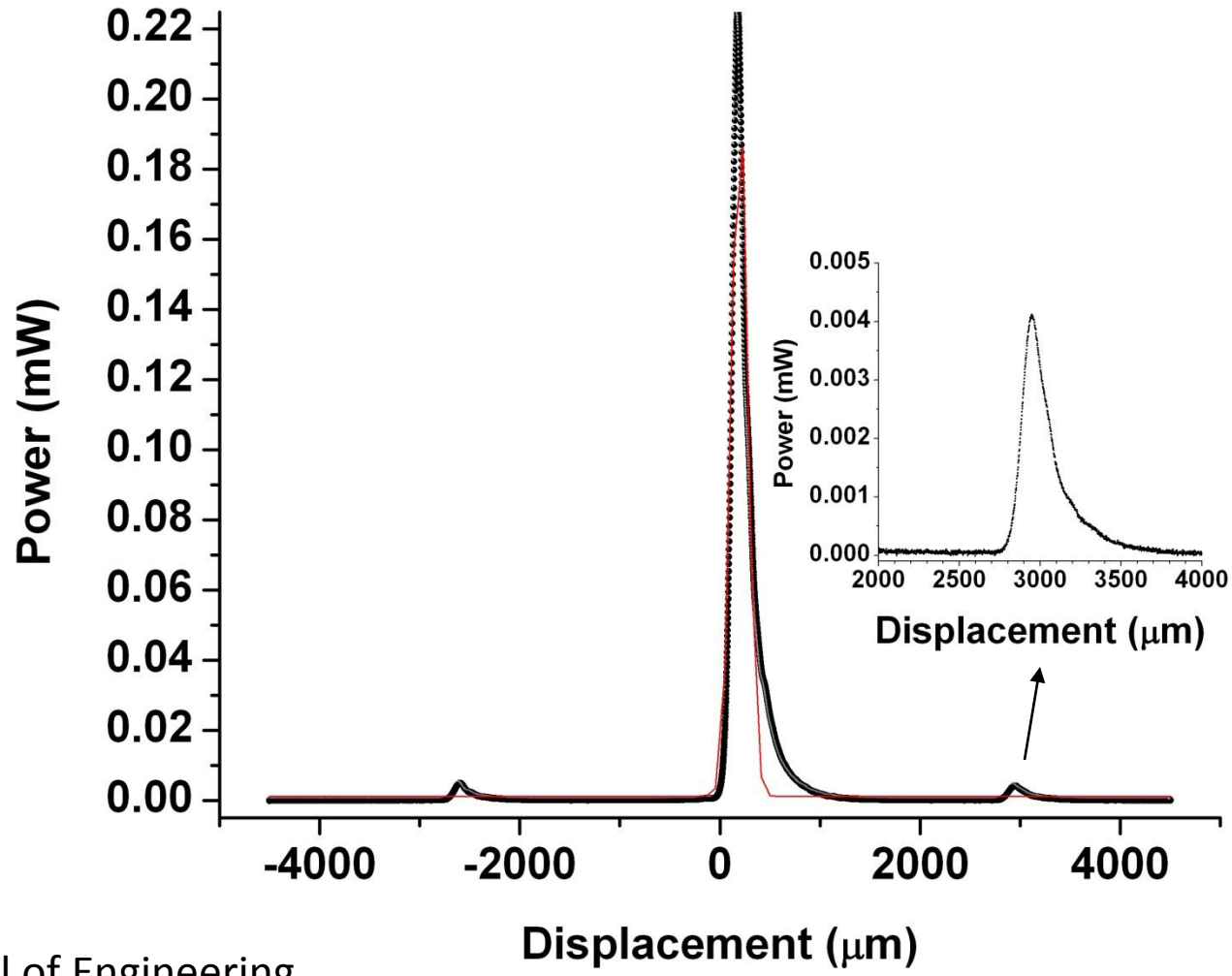




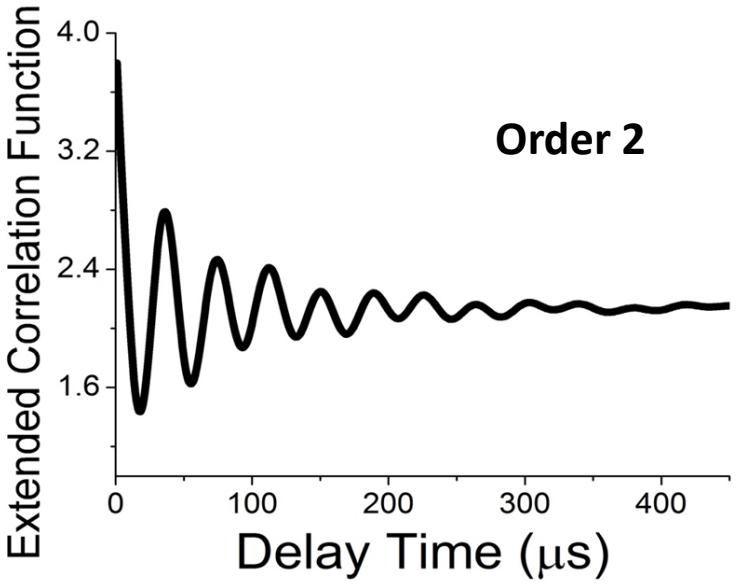
The Image of the 500 1/cm Phase Grating Water/Vapor Interface

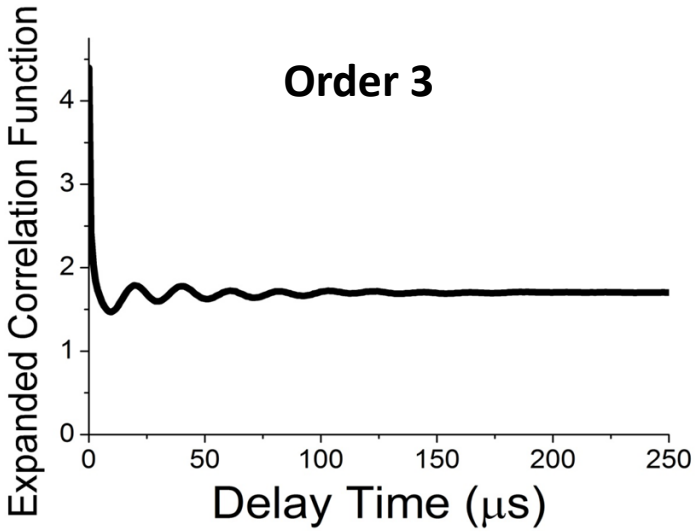


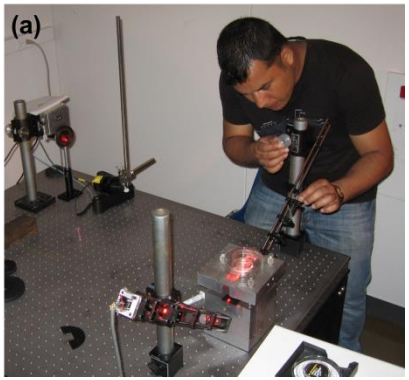
Power Measured at the detector plane: 0-order spot and the +1, -1 order spots



Orders 1 q=503.52 1/cm
Order 2 q=925.6 1/cm

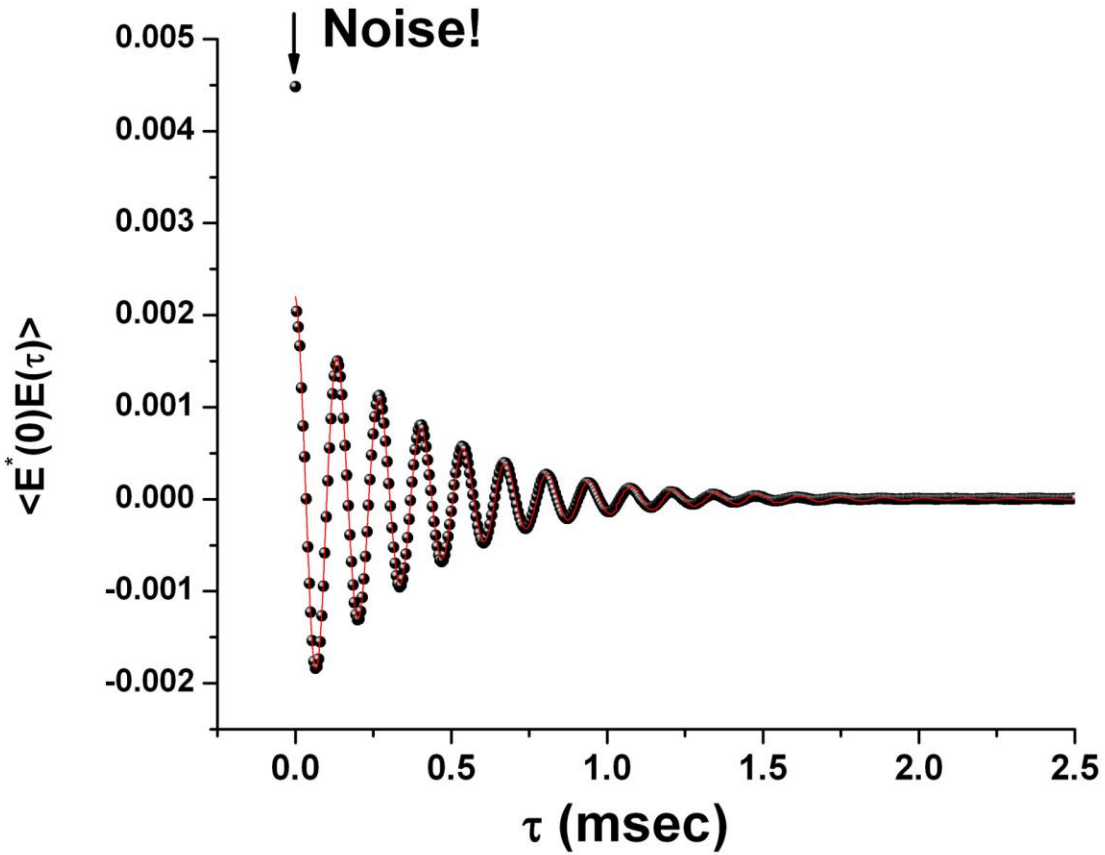




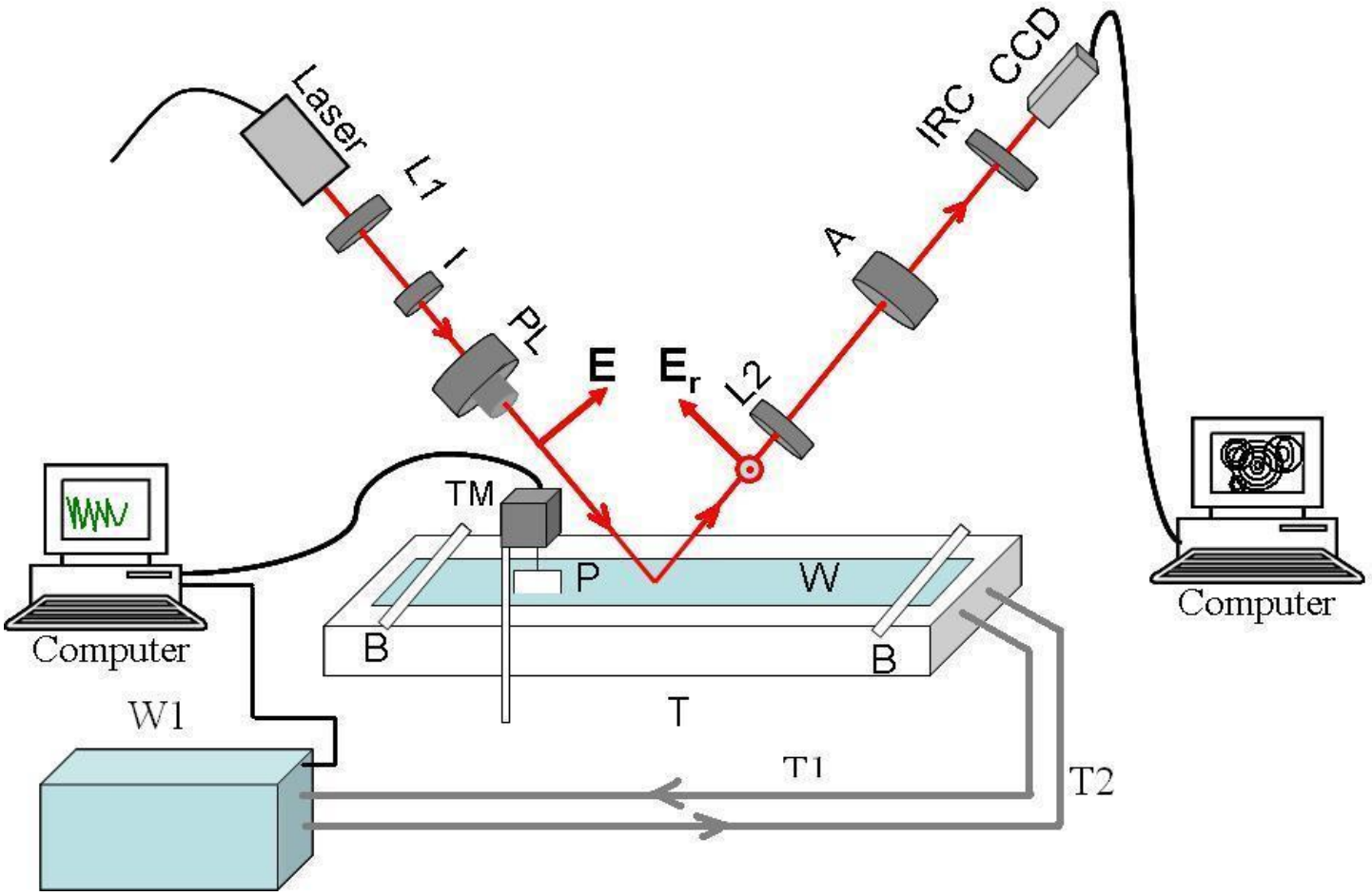


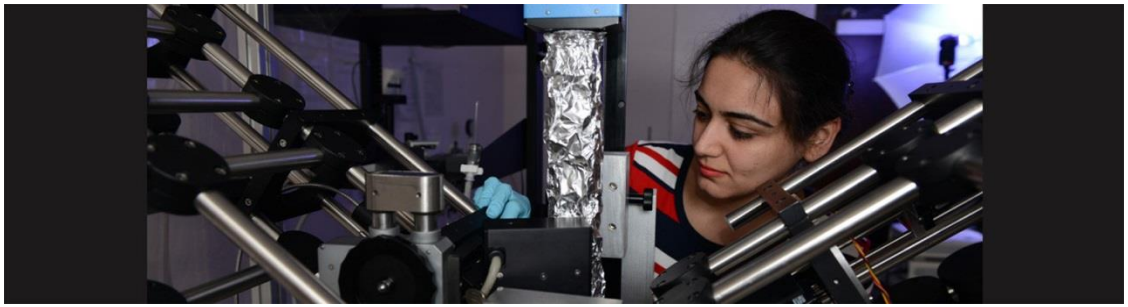
W. Roy

Correlation Function for Capillary Waves of 0.2 nm rms Amplitude



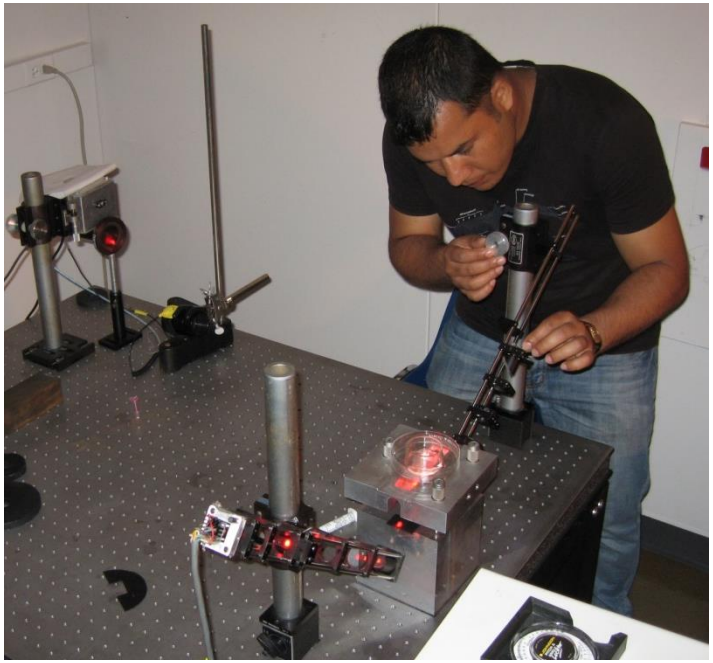
KSV Langmuir Monolayer System with Brewster Angle Microscopy (BAM)





M. Mirheydari

E. Mann

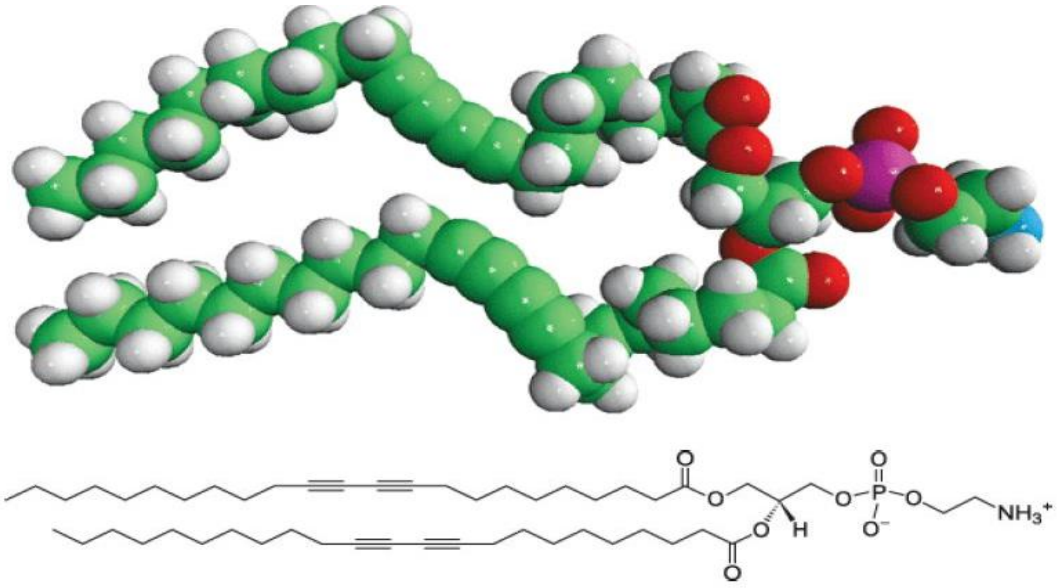


W. Roy

J. Wintersmith


100 µm

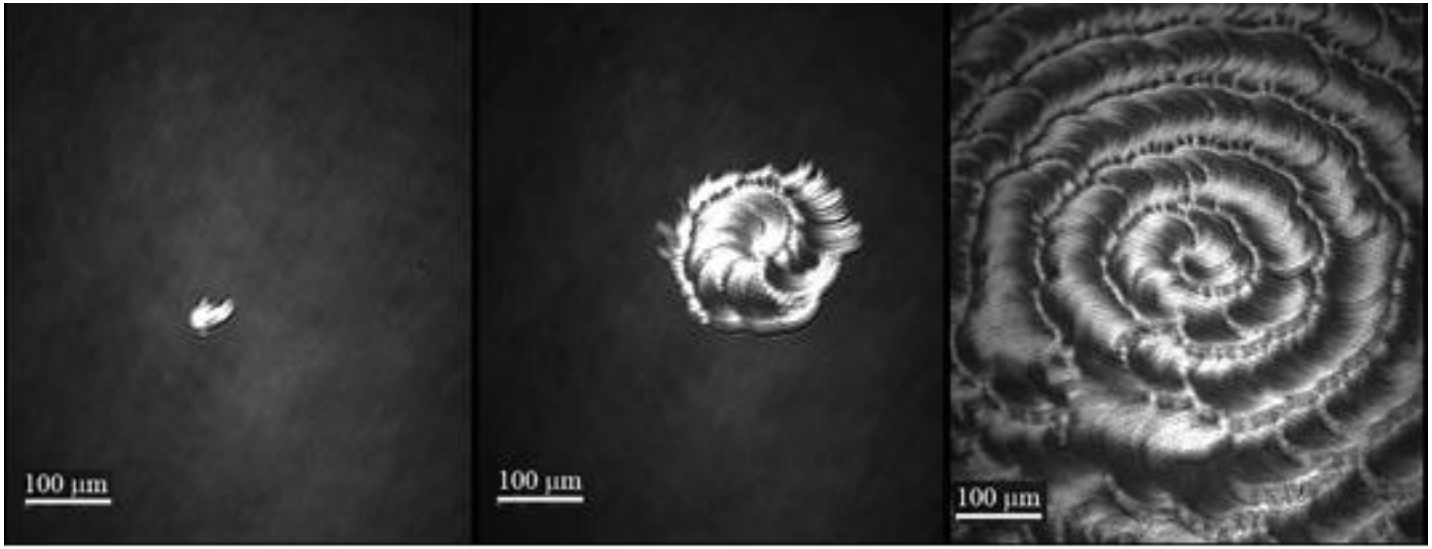
1,2-bis(10,12-Tricosadiynoyl)-sn-Glycero-3-Phosphoethanolamine



Pattern Formation in Langmuir films of ***Chiral*** Lipids

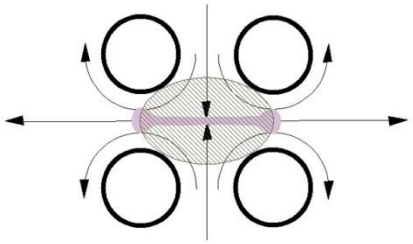
Prem Basnet, E. K. Mann, S. Chaieb

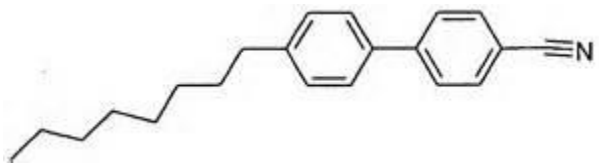
1,2-bis(10,12-Tricosadiynoyl)-sn-Glycero-3-Phosphoethanolamine]

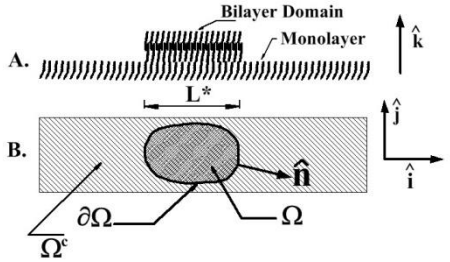


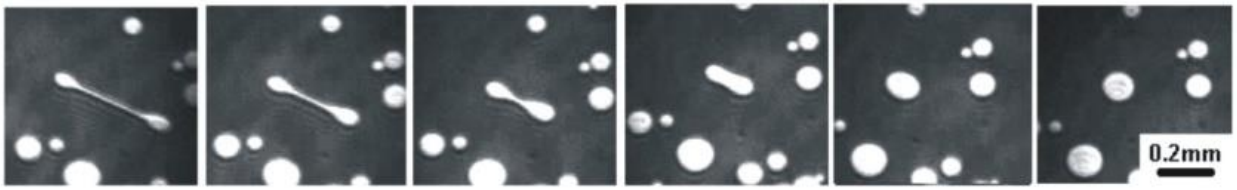
Nucleation t = 0 sec **Growth t = 4.3 Sec** **Spiral t = 38.6 sec**

Determination of a Line-Tension

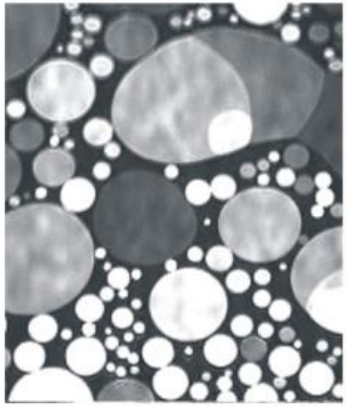


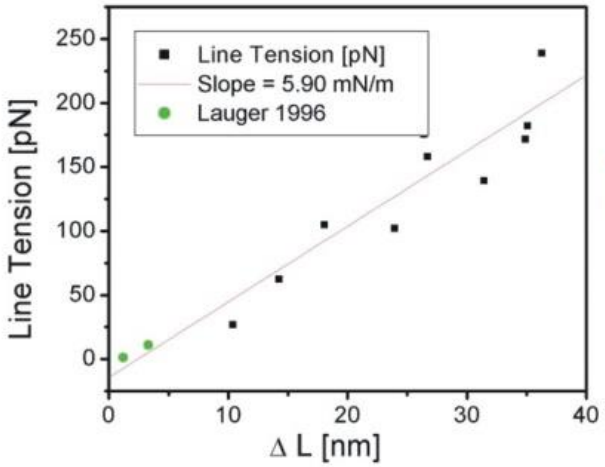


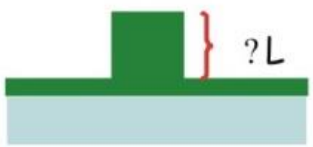




Time interval: 0.5 sec

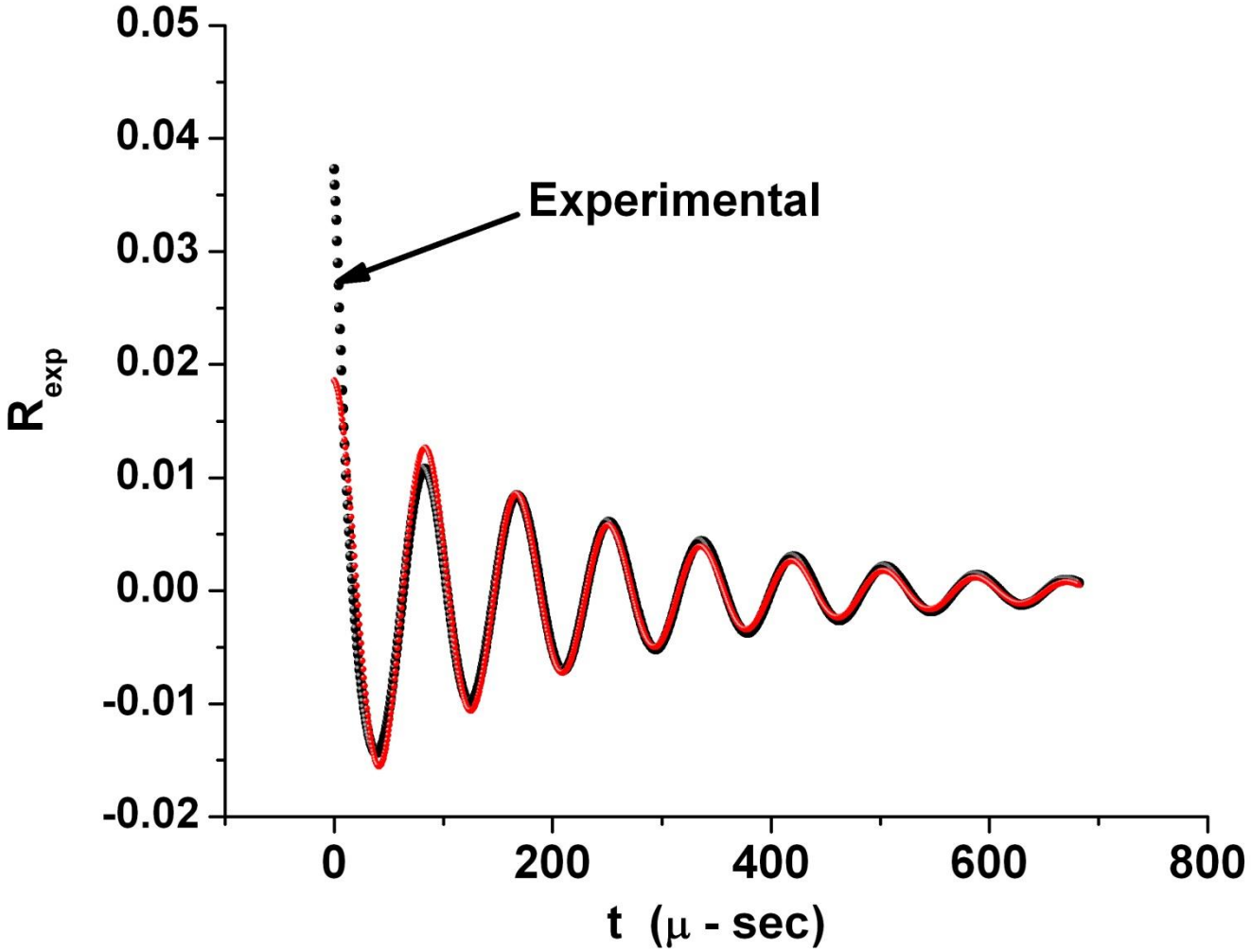






J. Wintersmith

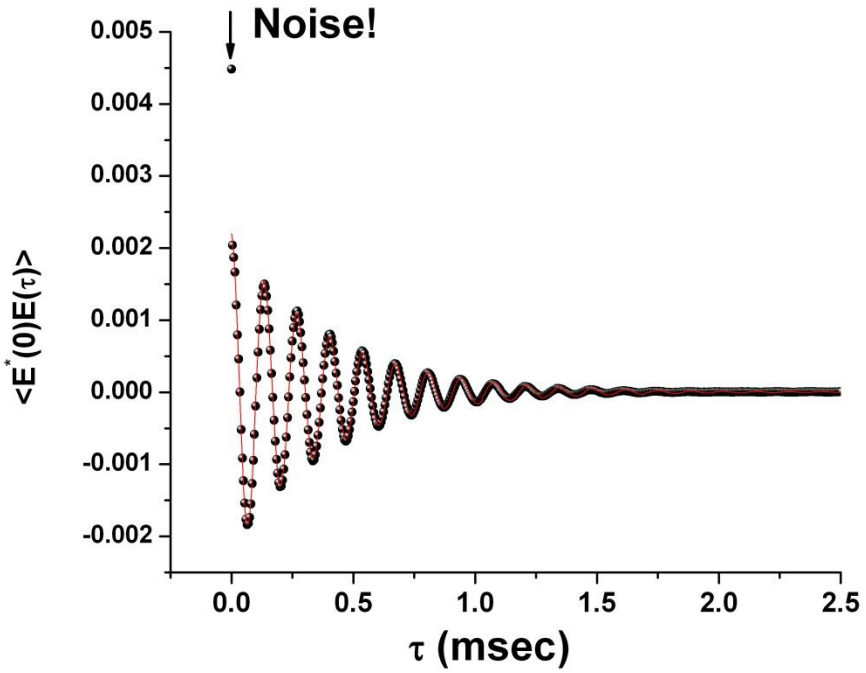
One Conclusion: SLSS + BAM!

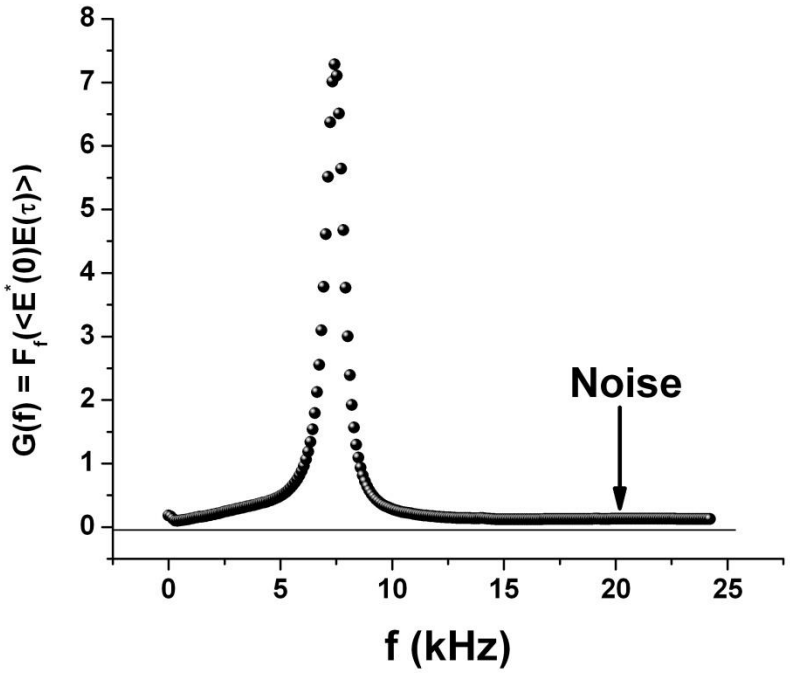


Nabin Thapa

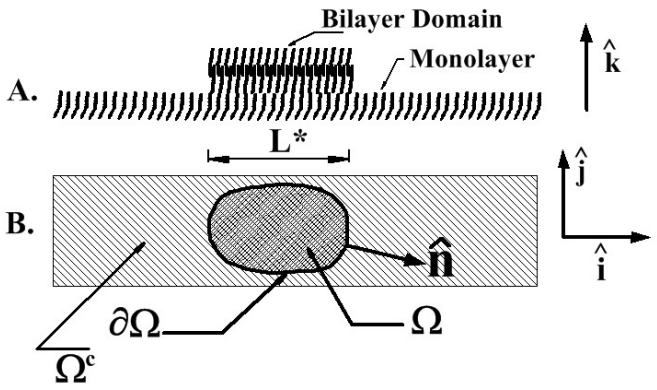
Case School of Engineering and Kent State University (physics department)

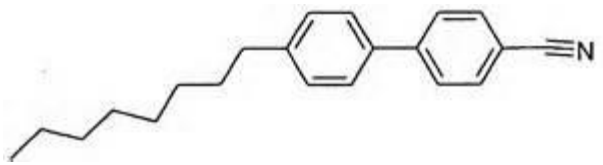
An “Acceptable” Correlogram And a “Precise” FFT Spectrum

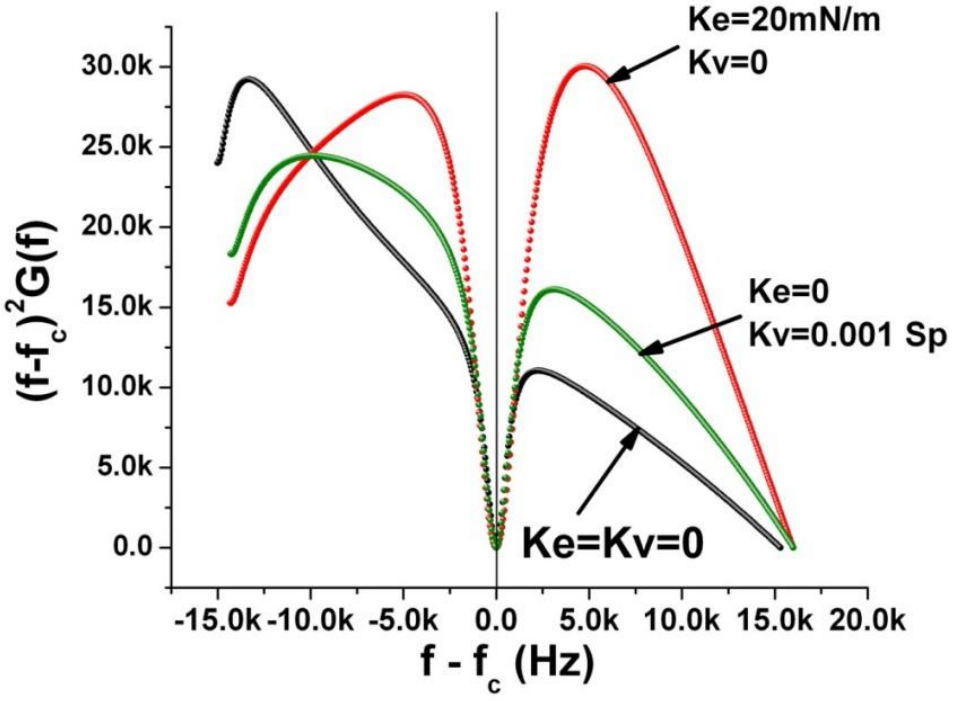




The Variation of the Second Moment of the Spectrum

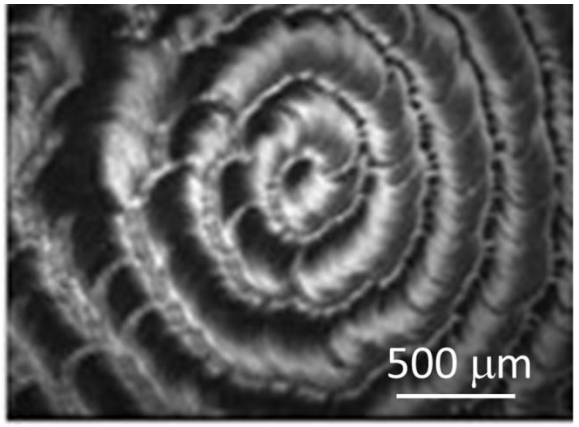




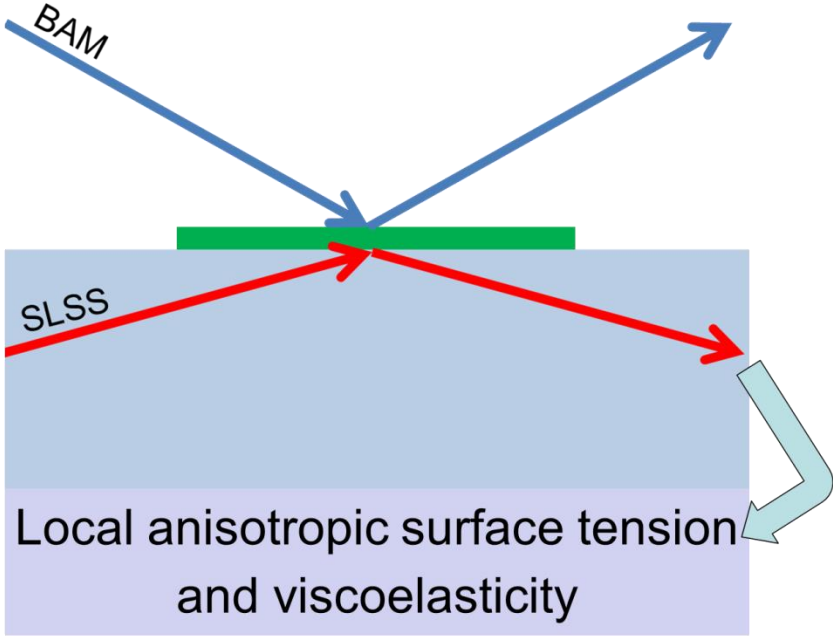


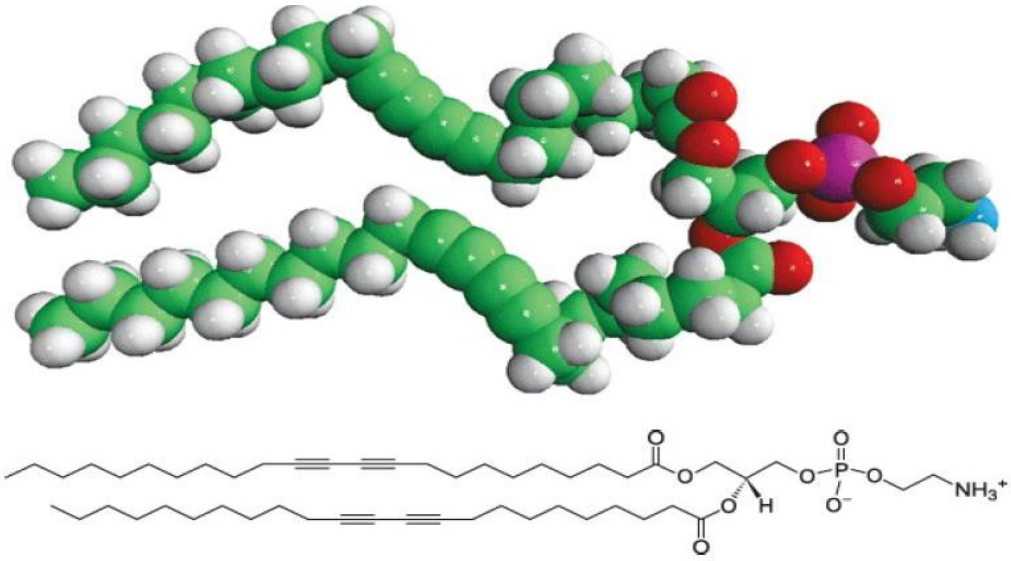
4-octyl-4-cyanobiphenyl (8CB)

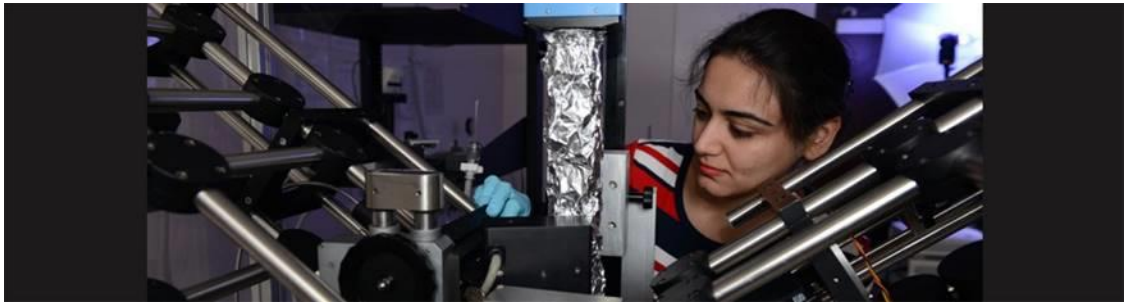
Now To Combine BAM and SLSS



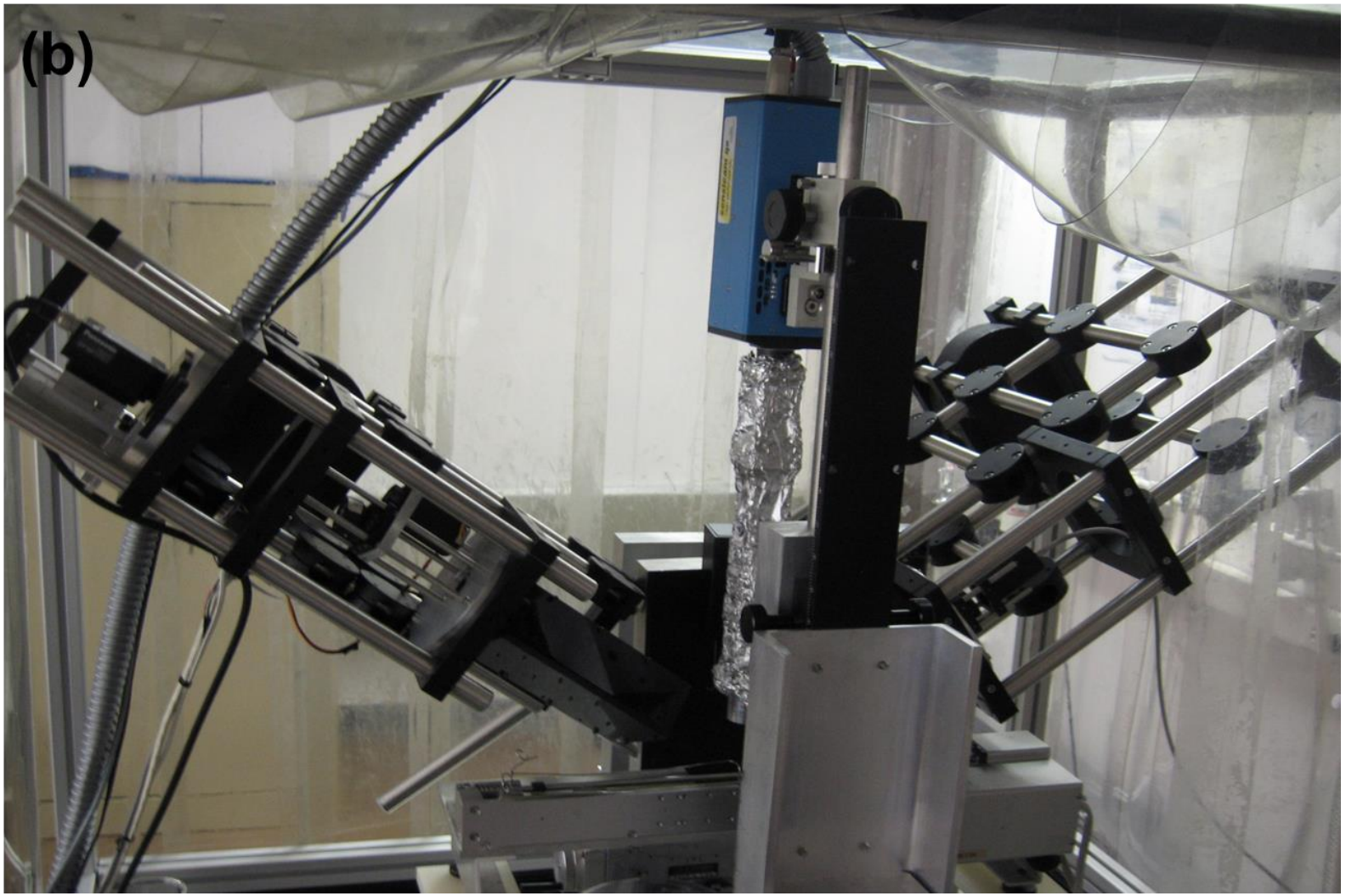
Nabin Thapa



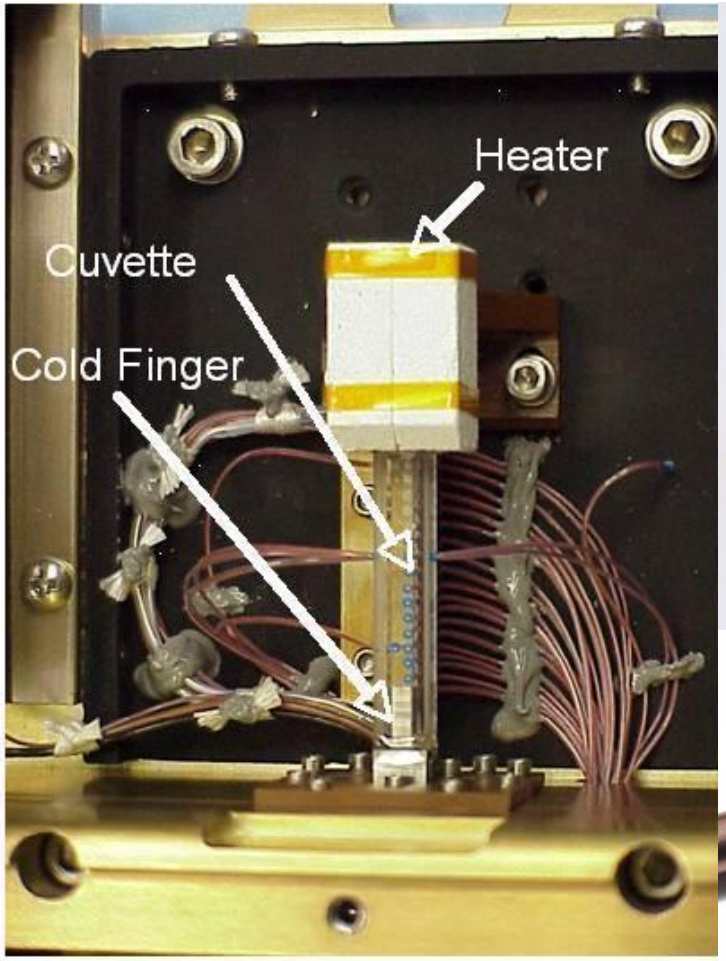


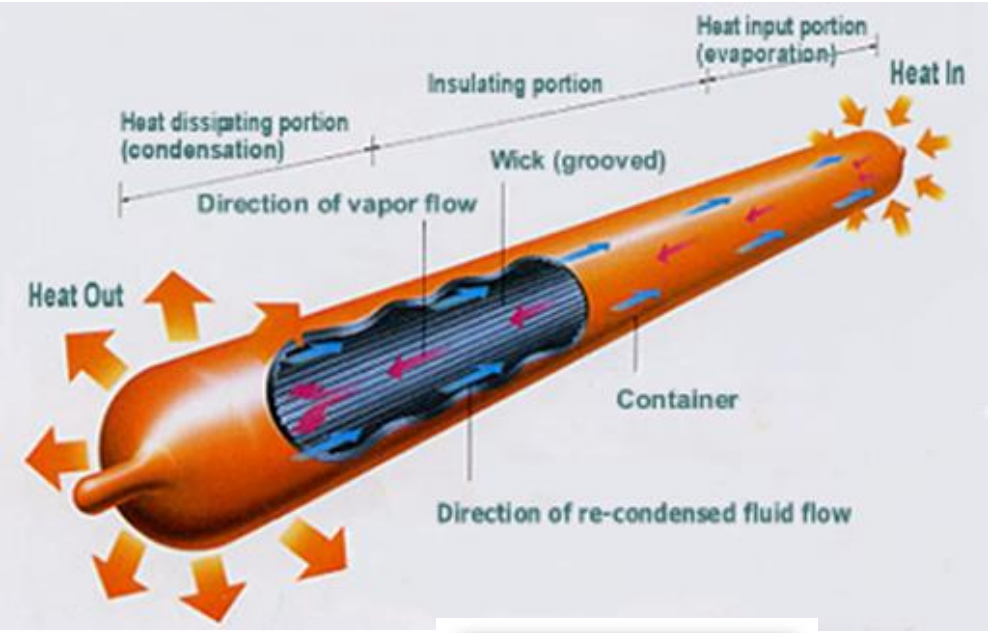


Mona Mirheydari



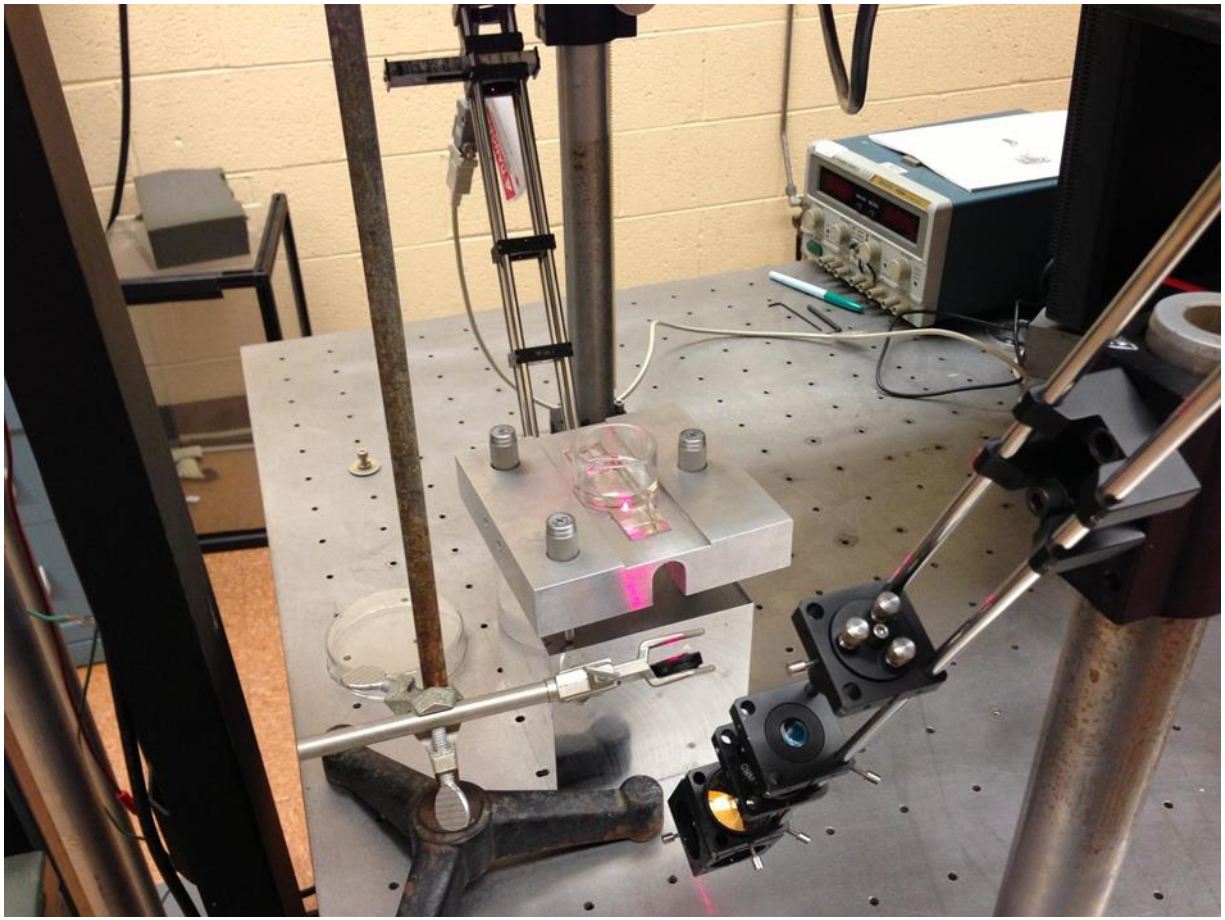
NASA Application: CVB-2 (Constrained Vapor Bubble) Wickless Heatpipe Experiment



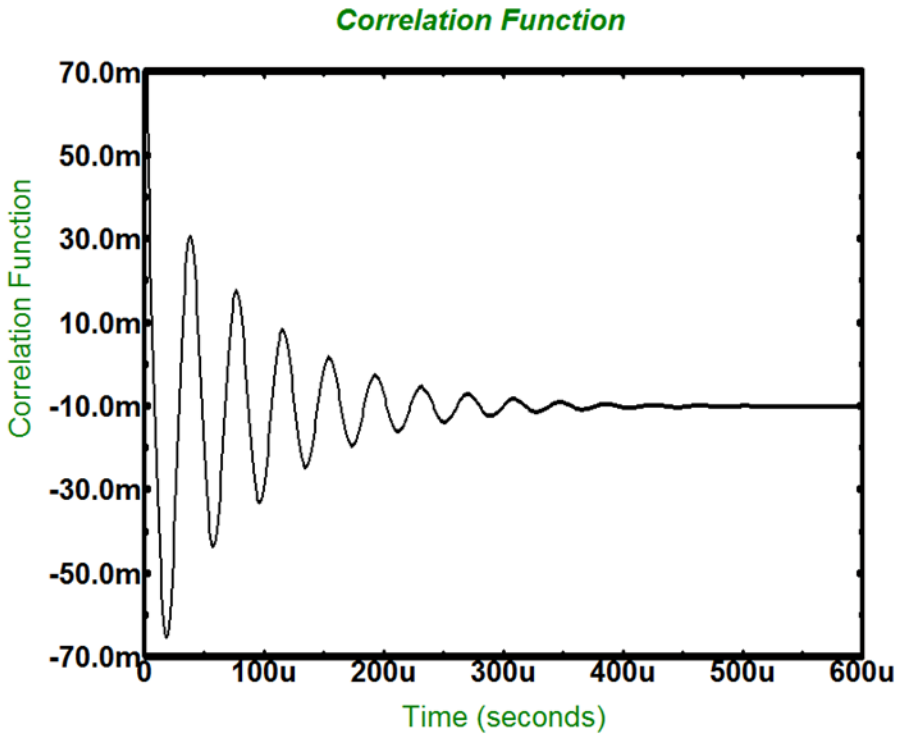


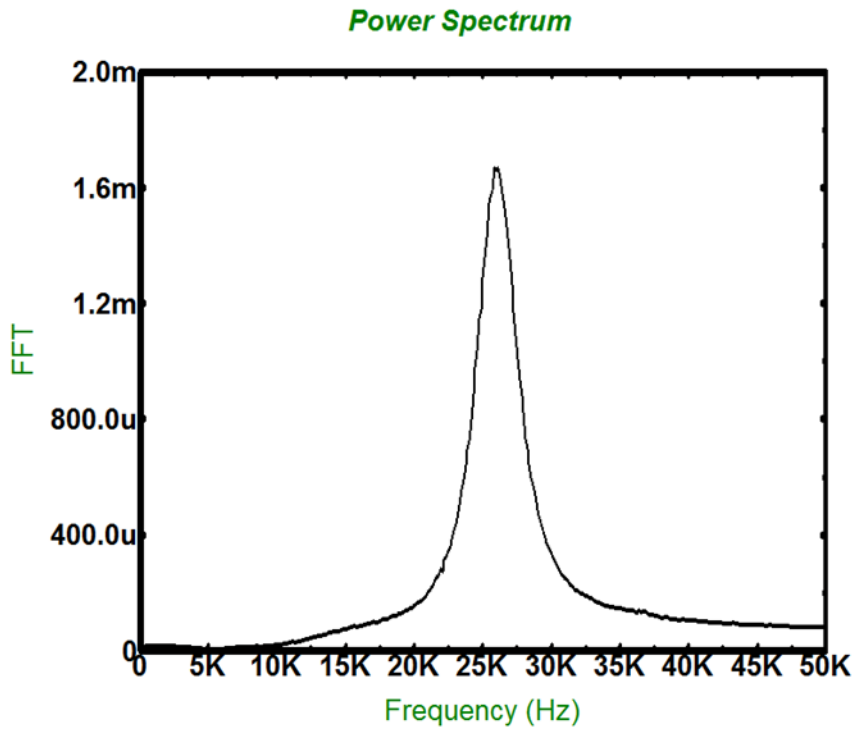
Grating Constant Determined Against Three Fluids of Known Surface Tension

q = 1022.1 1/cm

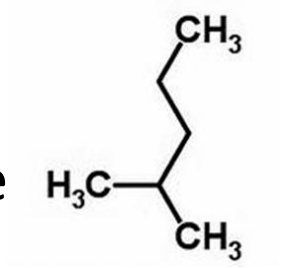


Correlation Function and its FFT
50% Mixture Pentane and 2-Methyl Pentane



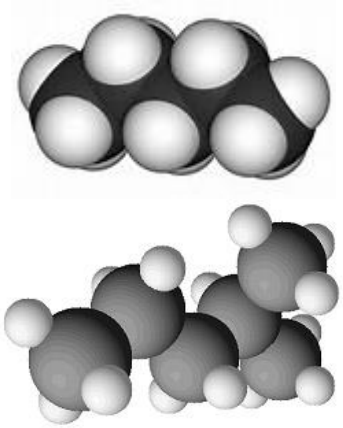


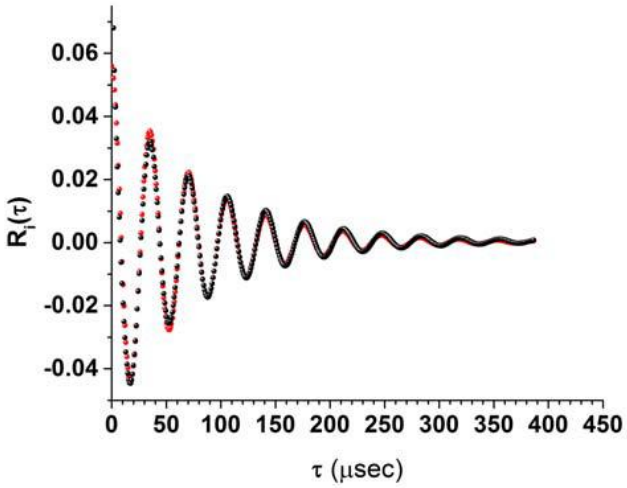
2-methyl pentane

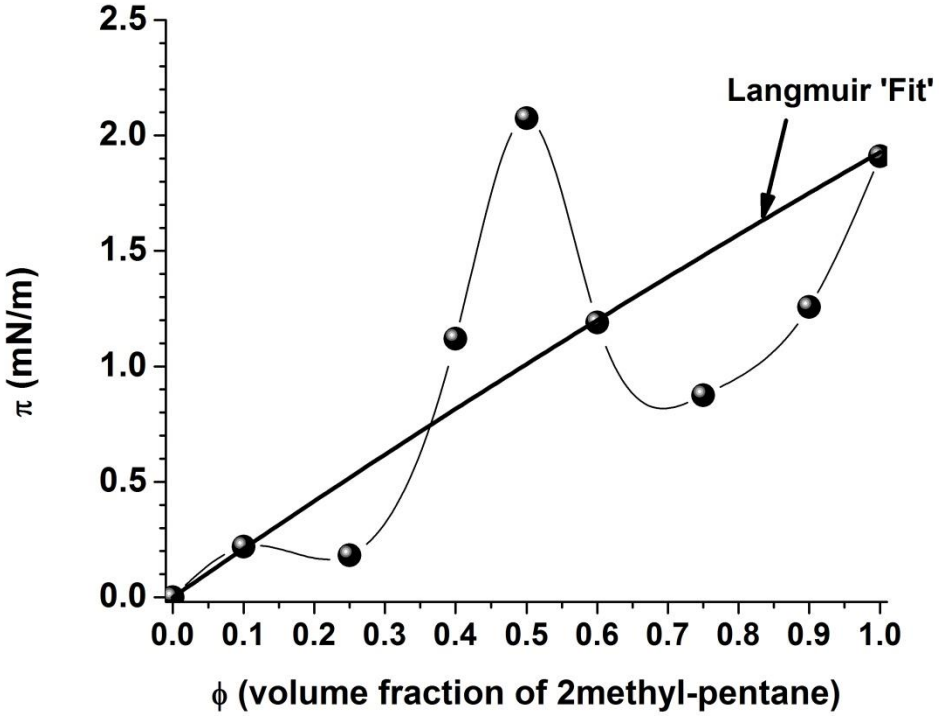


Pentane

We Expected a Langmuir Fit!

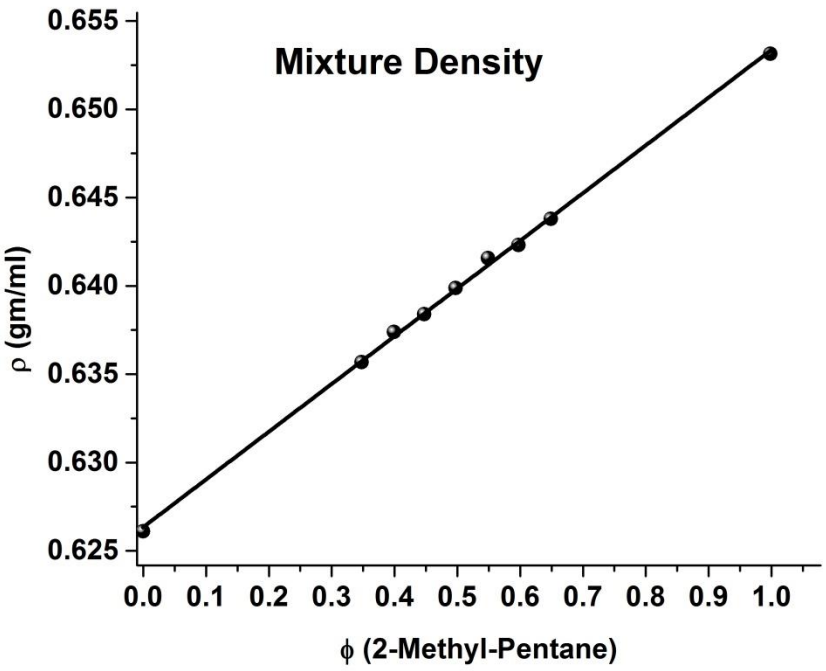






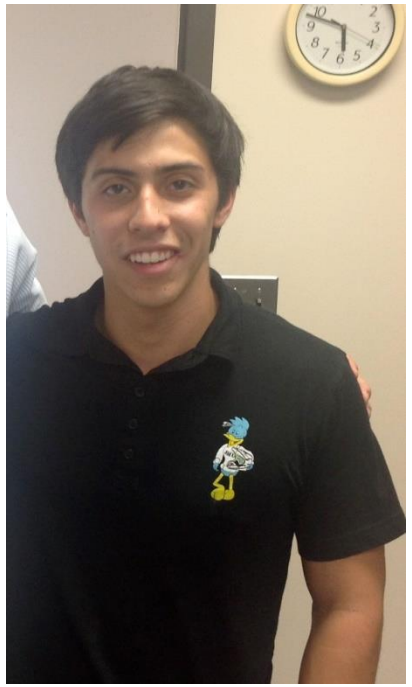
$$\frac{(\rho^- + \rho^+)\omega_c^2}{\gamma|q^3|} = Y_1 \approx 1$$

The Density of the Mixtures Were Measured



This data justifies the Linear combining rule used
In estimating Y1.

Zdenka Policova
University Toronto



N. Schambach
Johns Hopkins
NASA summer student